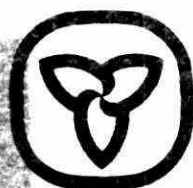


AN ASSESSMENT OF
PESTICIDE RESEARCH
PROJECTS FUNDED BY
THE MINISTRY OF THE
ENVIRONMENT THROUGH THE
ONTARIO PESTICIDES
ADVISORY COMMITTEE

1975-1976

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Committee

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Ontario

Ministry
of the
Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

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Executive Secretary to the Committee

* Succeeded in March 1976 by D.N. Huntley, B.S.A., M.S.A., Ph. D.,
LL.D.,

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RESEARCH PROJECTS FUNDED THROUGH THE ONTARIO PESTICIDES ADVISORY COMMITTEE

1975-76

1. SUMMARY

- 1) In 1975-76 the Ontario Pesticides Advisory Committee continued a research program established in 1973 with three major objectives:
 - a) To find alternative pesticides for those deemed environmentally hazardous and thus restricted in use.
 - b) To determine potential environmental hazards with pesticides currently in use.
 - c) To reduce pesticide input into the environment.
- 2) Thirty-seven applications for research grants totalling \$360,629 were received.
- 3) The total value of research grants awarded was \$136,017. The average value/grant was \$6,182 with a range of \$1,050-\$23,139.
- 4) Thirteen grants totalling \$78,884 were allocated for studies on the persistence, fate and potential environmental hazards to non-target organisms of pesticides currently in use. An earlier study on migration of pesticides from waste disposal sites was also completed.
- 5) Eight grants totalling \$52,333 were awarded for studies aimed at reducing pesticide input into the environment without loss of effective pest control.
- 6) One grant (\$4,800) was awarded for a study on biology and control of an agricultural insect pest. An earlier study on biting fly control in Ontario was also completed.
- 7) The Pesticides Advisory Committee concludes that, with few exceptions, the research done was of high calibre and that productivity was good. It is recognized that with the limited funds available the program of grants can be expected only to act as a catalyst in stimulating research in the broad areas included in the Committee's Guidelines and for which there is still an urgent need.

II RECOMMENDATIONS

The Pesticides Advisory Committee recommends that:

- 1) The Ministry of the Environment continue the program of grants to encourage pesticide research.
- 2) The program continue to be supervised by the Pesticides Advisory Committee following guidelines developed over the past three years.
- 3) Funds in the amount of \$200,000. be made available for the program in 1977-78.

III REVIEW OF THE RESEARCH PROGRAM

In 1973 the Ministry of the Environment allocated funds to the Ontario Pesticides Advisory Committee to sponsor pesticide research. Results obtained in the first two years (OPAC, 1974b; 1975a) were such that the Advisory Committee recommended the program be continued under its supervision. The Committee is gratified that these recommendations have been accepted and that the Ministry has seen fit to increase the research budget from \$100,000 in 1973-74, to \$135,000 in 1974-75 and \$150,000 in 1975-76.

Initially the Advisory Committee developed terms of reference to govern the awarding of research grants based on three objectives i.e. the need to find suitable replacements for pesticides deemed environmentally hazardous and restricted in use in Ontario; the need to determine if pesticides presently in use pose any serious environmental hazard; and the need to develop more effective approaches to pest control leading to a reduction in pesticide input into the environment. The "Call for Grant Requests" (Appendix I), based on these objectives, invited research proposals: 1) leading to registration of environmentally acceptable pesticides especially for use on minor crops (Objective 1); 2) on the persistence, fate and biological significance of residues of pesticides or mixtures of pesticides on the environment (Objective 2); and 3) on economic thresholds of pests, improved pesticide application and pest monitoring techniques and alternative non-chemical methods of control. Invitations for applications for grants were sent out in January, 1975 (Appendix II) to personnel in universities, industry and government, with the deadline for receipt of applications being February 28, 1975. Recommendations on grants to be awarded were made in April and June, 1975.

Thirty-seven applications were received from personnel in universities (32), industry (2) and an organization representing Ontario farmers (3) totalling \$360,629. University applications were from Guelph (12) Waterloo (7), York (5), Western (3), Brock (2), Queen's (2) and Toronto (1).

Applications were considered first by the research sub-committee (Dr. C.D. Fowle, Dr. R. Frank, Mr. K.G. Laver, Dr. F.L. McEwen, Dr. G.R. Stephenson and Dr. C.R. Harris (Chairman), and then by the Advisory Committee. The Committee recommended 21 grants totalling \$134,267. An additional grant of \$1,750. was recommended later in the year, i.e. 24 grants in all totalling \$136,017 (Appendix IV). The average value of the grants was \$6,182. (\$1,050-\$23,139). Nineteen of the 22 grants were made to universities (Guelph, 8; York, 3; Waterloo, 3; Western, 3; Brock 1; Toronto 1) one to industry and two to a growers' organization. Completion of two projects initiated in 1973 and 1974 respectively was also expected in 1975.

Direction and progress of the research program was monitored by the Advisory Committee in several ways. Initially several applicants were asked to modify their proposals to better meet the Committee objectives. In several instances the Advisory Committee invited proposals on specific problems. Informal contacts between the research subcommittee and some of those holding grants were established during the year. In January, 1976, the Advisory Committee sponsored a two-day seminar at which recipients of grants presented summaries of their progress. This seminar, held each year, has been most successful. It enables members of the Advisory Committee to meet the scientists involved, to assess their work and to make constructive suggestions.

The scientists are equally enthusiastic as the seminar provides them with an opportunity to present their own results and to meet with others involved in pesticide research. In addition to the steps outlined above, recipients of grants were asked to provide a progress report (Abstract) by December 31, 1975. These are included in this report (Appendix V).

Progress made in 1975-76 relative to the objectives of the program may be summarized as follows:

Objective 1: To find effective alternative pesticides for those deemed environmentally hazardous and thus restricted in use.

One grant (\$4,800) related to this objective. In addition completion of a major study on "Mosquito control in Ontario" which was initiated in 1973 (\$15,065) and continued in 1974 (\$8,175) was expected in 1975-76.

As has been pointed out in earlier reports (OPAC, 1974b, 1975a) there were alternative insecticides available for control of most insect pests in Ontario when use of the organochlorine insecticides was restricted in 1969-70. However, control measures were lacking for some soil insect pests (OPAC, 1974a) particularly cutworms and flea beetles and populations of these pests appear to have increased in recent years. Research supported in part by OPAC resulted in registration of one insecticide which was effective against cutworms attacking vegetable crops (OPAC, 1974b). In addition the Advisory Committee funded a two-year study on the biology and control of the crucifer flea beetle in Ontario (18).^{*} Results of the study indicated that: 1) the increasing incidence of flea beetle damage to cruciferous crops in Ontario may be correlated in part with declining residues of dieldrin and DDT in agricultural soils; 2) the flea beetle has one or two generations/year in southwestern Ontario; 3) insecticides presently recommended for use are effective, in most situations, provided applications are properly timed; and 4) some experimental insecticides also show promise.

Prior to restrictions on their use, the organochlorine insecticides were used extensively in Ontario for biting fly control. Effective alternative approaches were not adopted when use of the organochlorine insecticides was stopped as there was considerable controversy as to whether biting fly control programs were effective or justified. The Pesticides Advisory Committee was well aware of the potential hazards associated with our failure to control biting flies, e.g. insect transmitted diseases such as encephalitis, and in 1973 requested the Universities of Waterloo and Guelph to prepare for the guidance of the Committee a working paper comprising: 1) a comprehensive review of the biting fly problem in Ontario; and 2) recommendations as to how the problem should be approached. The Advisory Committee planned to use this report as a basis for preparing recommendations on the biting fly problem for consideration by the Ministry of the Environment. This study (20) was completed early in 1976. Results have already been utilized, in part, in preparing recommendations concerning the encephalitis problem (OPAC, 1975b) and a more comprehensive report relating to the overall problem of biting fly control is being completed (OPAC, 1976).

^{*} Numbers in brackets refer to Abstracts of projects in Appendix V.

Objective 2; To determine potential environmental hazards with pesticides presently in use.

Thirteen grants totalling \$78,884 were allocated to this objective. A study funded in 1974 \$ (4,000) was completed also in 1975.

Studies on the persistence and fate of pesticides in the environment were continued. In the past there has been concern that pesticides deposited in waste disposal sites might migrate into underground water sources. In 1974 a project was initiated to monitor pesticide migration from selected waste disposal sites (9). Results of Phase 1 of this study indicated that while some pesticides could be detected in leachates at sanitary landfill sites, the amounts detected were well below maximum permissible levels.

Research over the past 5-10 years has shown that organophosphorus and carbamate insecticides which have replaced the organochlorine insecticides are not persisting in mineral soils in Ontario to any significant extent. However, preliminary data presented to the Advisory Committee in 1975 indicated that some organophosphorus insecticides were accumulating in organic soils used for vegetable production. The Committee therefore provided support for further investigation. A survey of insecticide residue levels in soil in the Holland Marsh indicated the presence of both organochlorine and organophosphorus insecticide residues (22). Concentrations of some insecticides were quite high e.g. DDT, ethion. Preliminary results of another study established at the request of the Advisory Committee indicated that residues of some organophosphorus insecticides were markedly more persistent in organic as compared to mineral soils as were the degradation products (21). Watershed studies in the Holland Marsh (22) indicated that low levels of organochlorine and organophosphorus insecticides were present in drainage ditch water, sediment and fish. Low levels of these insecticides were also detected in the Schomberg River. Laboratory studies indicated that some insecticides are absorbed strongly by the sediments, while others, e.g. diazinon, partition into the water (22). A study was also initiated to determine if herbicide residues are accumulating in organic soils. Emphasis was placed on development of appropriate analytical procedures. Preliminary data indicated significant quantities of linuron in some organic soils six months after application (16). Emphasis was also placed on development of a reliable analytical procedure for the systemic fungicide, benomyl, which is receiving wide use in Ontario. Results indicated that the earlier analytical procedure may have provided erroneous results and that the generally accepted view that benomyl degrades rapidly in water may not be correct (4).

Studies were continued or initiated on the biological activity of pesticide residues with emphasis on effects on non-target organisms. Results of a preliminary study on the effects of selected pesticides on meiotic spindle and chromosome movements were inconclusive (10). A study

on the persistence, mobility, degradation and biological activity of paraquat in soil was completed (15). Laboratory studies indicated that certain ions eluted paraquat from soils and caused migration. Under field conditions there was some photodecomposition and leaching but most of the compound remained in the surface 2 cm. of soil. Effects on soil micro-organisms and microbial activities were observed but usually at rates of application higher than those used under practical conditions.

As in previous years considerable emphasis was placed on potential effects of pesticide residues on non-target aquatic organisms with six inter-related studies being continued or initiated. In the laboratory the effect of several herbicides and insecticides on growth and fixation of nitrogen by blue-green algae was assessed. (6) In another laboratory study bioassays indicated that chlorpyrifos (Dursban (R) and Abate (R) may depress algal growth and in the field this was found to be the case with chlorpyrifos but not with Abate (3). Contradictory results were obtained in another study using artificial ponds (2) where chlorpyrifos and Abate stimulated algal biomass and photosynthesis. At the same time number of genera of algae were reduced. Other results indicated that chlorpyrifos reduced numbers of zooplankton and bacteria in artificial ponds (2). A laboratory and field study on the effects of sublethal concentrations of diazinon on stream invertebrates was continued. Results of laboratory tests indicated that diazinon was toxic to some species of invertebrates and had some behavioural effects at sublethal concentrations (14). In the field study carried out in a section of the Speed River diazinon, introduced every third day from July 9 to September 21, appeared to have no major effect on total numbers of invertebrates (14).

Objective 3: To reduce total pesticide input into the environment.

In the long term the only really practical approach to the problem of pesticide pollution of the environment is to modify pest control techniques in such a fashion that more effective control can be obtained with less input of chemical pesticides. The Advisory Committee considers this to be a prime goal of the research program and in 1975-76 supported eight research projects totalling \$52,333 under this objective.

In many instances pesticides are applied as "insurance" treatments. Often such treatments would not be required since the pest population might be present at low level which would not cause serious damage. It is thus important to determine economic thresholds below which pesticide application would not be required. During the past year a study was initiated on the economic threshold of cereal leaf beetle on oats and barley in Ontario (8). Preliminary results indicated that: 1) parasitism is fairly widespread in southwestern Ontario thus providing a significant degree of biological control; 2) oats in the head stage could tolerate eight larvae/plant without yield loss; and 3) barley was more susceptible than oats.

Pesticide application techniques are admittedly crude and sometimes only a fraction of the pesticide applied reaches the target. Thus development of more effective application techniques would result in a marked reduction in pesticide input into the environment.

The Committee is anxious to encourage more research in this field and supported two projects in 1975-76 relating to development of more effective methods of application. Research on a novel approach to pesticide application involving electrostatic application, which has been supported since 1973 was continued. Results in both laboratory and field tests indicated that particle deposition on the target was markedly higher with charged as compared to uncharged particles (13). On a more immediate practical level results of another project indicated that addition of either of two adjuvants resulted in a significant reduction in herbicidal drift as compared to standard herbicide/water treatments (23). This finding has important applications, particularly with regard to reducing herbicidal drift in roadside spraying.

Development of more effective methods for predicting appearance of pests could also result in a marked reduction in pesticide use, e.g. with proper timing there would be less requirement for "insurance" applications. Two research projects relating to development of effective pest monitoring techniques have been funded since 1973. Development of an effective program for monitoring for pests of apples has advanced well (19). Promising progress also is being made in reducing fungicide use on carrots and onions by scheduling sprays in relation to weather conditions (12). Tests in commercial growers' fields in 1975 indicated that carrot leaf blight could be controlled with sprays scheduled in this way. Number of fungicide sprays could be reduced by from one third to two thirds as compared to present spray calendar recommendations while still achieving better control.

In a few instances alternative non-chemical methods of pest control may be feasible. A study into the feasibility of biological control of St. John's Wort in Ontario was supported for the second year (1). A study was also initiated to determine the feasibility of using an integrated approach to disease control in turf grass (11). Preliminary results indicated that in some instances fungicides are used extravagantly to control diseases of managed turfgrass. The two major diseases were identified as Helminthosporium blights and Dollar spot. Field tests indicated that the latter was not controlled by systemic fungicide which have been highly recommended for this purpose. Laboratory tests indicated a high level of resistance to this group of chemicals. Several other contact fungicides were found to be effective. The project on biological control of the onion maggot using the sterile male technique, in progress for several years, was supported again in 1975-76 (17). A large scale field test was conducted at the Keswick Marsh using sterile flies obtained from irradiated pupae. Results obtained were disappointing, particularly in view of promising data obtained in previous years. For reasons which are not clear released flies didn't survive well. Aircraft dispersal of pupae was tested and emergence of dropped pupae was not impaired. In a smaller field test the feasibility of using chemosterilized adults was tested. Results showed some promise - egg hatch was depressed by an average of 40% throughout the season; an expected third peak in the fly population did not appear; and maggot damage to onions was negligible.

ASSESSMENT

In assessing progress over the past three years of operation it is apparent that the value of the research done far exceeds the relatively small amount of funding provided by the Ministry of the Environment.

The immediate goals falling under Objective I have been accomplished. Satisfactory alternative insecticides have been developed for most agricultural insect pests for which no effective control programs were available when use of the organochlorine insecticides was restricted in 1969-70, e.g. tarnished plant bug, and cutworms. Nevertheless other problems may still arise. Research indicates that the residues of the organochlorine insecticides are declining slowly in agricultural soils. The crucifer flea beetle study indicated that these residues are now dropping below "bioactive" levels and this may be contributing to the increase in flea beetle populations. Similar problems could develop with other soil insects. Also with some insect pests, e.g. the onion maggot, it is necessary to utilize many applications of less residual organophosphorus or carbamate insecticides in a single growing season whereas two or three applications of organochlorine insecticides sufficed. Such extreme selection pressure is hastening the development of resistance to organophosphorus and carbamate insecticides. Development of effective methods of biting fly control remains a major problem. The encephalitis outbreak in Ontario in 1975 clearly illustrated that, as many entomologists have warned since 1970, Ontario must develop effective programs for management of biting flies. The Advisory Committee is hopeful that its recommendations (OPAC, 1975b, 1976) will aid the Ministry of the Environment and other agencies concerned in developing the short and long term research programs required for solution of this pressing problem.

Good progress has also been made under our second objective on studies on the persistence and fate of pesticides in the environment. Generally, residues of pesticides presently recommended for use do not appear to constitute a problem in mineral soils. However, residues are being detected in organic soils. Research aimed at defining the extent of the problem is underway. Residues of pesticides presently recommended for use in Ontario are, with one or two exceptions, not being detected to any significant extent in Ontario streams and lakes. Although strongly supported over the past three years less progress has been made in defining the potential biological and environmental hazards of pesticides now in use. With regard to soils it appears that any side effects on soil organisms are temporary in nature. Results obtained with aquatic organisms have been contradictory. While no clear conclusions can yet be arrived at, it appears that, considering the low levels of current pesticides being detected in water, any side effects will be minor. A potential problem does exist in cases where pesticides are deliberately introduced into the aquatic ecosystem. For example, insecticide concentrations necessary to achieve control of biting fly larvae may affect non-target organisms.

Research aimed at reducing pesticide input into the environment while at the same time achieving more effective pest control (Objective 3) is progressing very well. Development of information on economic thresholds, better application equipment, pest monitoring techniques and

alternative non-chemical methods of control will all contribute to meeting this objective. The Advisory Committee, with a small research budget can only fund "model studies" which hopefully will serve to illustrate to concerned federal and provincial government agencies and industry what could be accomplished on a much larger scale if adequate funds were provided for research.

The Pesticides Advisory Committee is satisfied with research progress made in the past three years and recommends continuation of the research program under the supervision of the Committee. Part of the success of the program has been due to the fact that it has deliberately been kept small, thus allowing consultations. Nevertheless research costs have risen drastically in the past few years while research funds from other sources have been drastically cut back. The Ministry of the Environment has recognized this problem and has increased the budget from \$100,000 in 1973-74 to \$150,000 in 1976-77. To maintain the program at its present level a budget of \$200,000 in 1977-78 would be realistic.

IV REFERENCE CITED

Ontario Pesticides Advisory Committee. 1974a. Review of soil insects in Ontario, 1900-1973. 28p.

Ontario Pesticides Advisory Committee. 1974b. An assessment of research projects funded by the Ministry of the Environment through the Ontario Pesticides Advisory Committee, 1973-74. 33p.

Ontario Pesticides Advisory Committee. 1975a. An assessment of research projects funded by the Ministry of the Environment through the Ontario Pesticides Advisory Committee, 1974-75. 36p.

Ontario Pesticides Advisory Committee. 1975b. In-house interim report on the mosquito problem in Ontario dealing specifically with encephalitis. 10p. (Confidential).

Ontario Pesticides Advisory Committee. 1976. Mosquitoes and mosquito control in Ontario. In preparation.

APPENDIX 1. Format of advertisement inviting applications for research grants from the Ontario Pesticide Advisory Committee, 1975-76

CALL FOR GRANT REQUESTS

The Ontario Ministry of the Environment has a limited amount of funds available for 1975 to sponsor research that will reduce the overall use of pesticides and find alternatives where possible for those that may be environmentally hazardous. Funds will be made available on the basis of a negotiated contract for specific research projects. Preference will be given proposals that will yield results in a relatively short time (less than three years), and funds will be committed on a one-year basis. Research should be in the context of normal use patterns.

The Ministry invites proposals in the following areas:

1. The economics of pest control including economic threshold levels of pests.
2. Research leading to the registration of environmentally acceptable pesticides, especially for use on minor crops, including vegetables, greenhouse crops, and ornamentals.
3. Reduction of pesticide usage through development of effective pest monitoring techniques, alternative non-chemical methods of control, or improved application techniques.
4. Interactions and effects of pesticides or mixtures of pesticides on non-target organisms.
5. Development of information on time which should elapse between dates of treatment and re-entry into treated areas.
6. Studies on the persistence, fate and biological significance of pesticides on the environment with particular reference to parathion, carbofuran, chlordane and its metabolites, and benomyl.

APPLICATION PROCEDURE

Research proposals should be submitted to:

The Chairman,
Pesticides Advisory Committee,
Ontario Ministry of the Environment,
Fifth Floor, Mowat Block,
Queen's Park,
Toronto, Ontario.
M7A 1A2.

Applications should include the following:

1. Title of project.
2. Name, address and affiliation of applicant (s)
3. Discussion of problem.
4. Clear statement of objectives.
5. Plan for the program.
6. Facilities available to the researcher for the conduct of the program.
7. Budget - categorize costs as: Personnel - full time and part time; equipment; supplies; other.
8. Listing of current projects and other sources of funding.
9. Curriculum vitae on principal investigator (s).

Applications should be received by February 28th, 1975.

APPENDIX II. "Call for Research Grants": Mailing List 1975-76

ALEX, J.F., Dept. of Environmental Biology, University of Guelph,
Guelph, Ontario.

ARMSTRONG, M.L., Ontario Fruit & Vegetable Growers Association,
Food Terminal, 185 The Queensway, Toronto, Ontario

BAARCHERS, W.H., Lakehead University, Thunder Bay, Ontario.

BANDEEN, J. D., Crop Science Dept., University of Guelph, Guelph, Ontario.

BARLOW, C. A., Carleton University, Ottawa, Ontario.

BROWNE, C. R., Senior Project Development Officer, Ontario Research
Foundation, Sheridan Park, Mississauga, Ontario.

BROWN, J.R. School of Hygiene, University of Toronto, Toronto, Ontario.

BUNTING, John W., Dept. of Chemistry, University of Toronto, Toronto, Ontario.

CHADWICK, June M., Dept. of Microbiology, Queen's University, Kingston, Ontario

CHAPMAN, R.A., University of Western Ontario, London, Ontario.

CHEFURKA, P.M., University of Western Ontario, London, Ontario

CHIBA, M., Dept., of Chemistry, Brock University, St. Catharines, Ontario.

COLEMAN, B., Dept. of Biology, York University, 4700 Keele Street, Toronto
Ontario.

CORKE, Charles T., Dept. of Microbiology, College of Biological Science,
University of Guelph, Guelph, Ontario.

DOWNE, A.E.R. Queen's University, Kingston, Ontario.

FENTON, M.B., Carleton University, Ottawa, Ontario.

FLETCHER, R.A. Dept. of Environmental Biology, University of Guelph,
Guelph, Ontario.

FORER, A., Dept. of Biology, York University, 4700 Keele St.,
Downsview, Ontario.

FOWLE, C.D. Dept. of Biology, York University, 4700 Keele St.,
Downsview, Ontario.

- FROSST, Alan C., McMaster University, Hamilton, Ontario.
- FROST, Roger A., Faculty of Science, Dept. of Zoology, University of Western Ontario, London, Ontario.
- GIBO, D., Erindale College, University of Toronto, Toronto, Ontario.
- GILLESPIE, T.J. Dept. of Land Resources Science, University of Guelph, Guelph, Ontario.
- HARMSSEN, R., Biology Dept., Queen's University, Kingston, Ontario.
- HOLSWORTH, Wm. N., University of Western Ontario, London, Ontario.
- HUTCHINSON, T.C., University of Toronto, Toronto, Ontario.
- INCULET, I.I., Faculty of Engineering Science, The University of Western Ontario, London, Ontario.
- KAYE, B.H., Director of Fine Particles Research Institute, Laurentian University, Sudbury, Ontario.
- KETCHESON, J.W. University of Guelph, Guelph, Ontario.
- KNERER, Gerd, University of Toronto, Toronto, Ontario.
- MAHANEY, W.C., York University, 4700 Keele Street, Downsview, Ontario.
- MAYFIELD, C.I., Faculty of Science, Dept. of Biology, University of Waterloo, Waterloo, Ontario.
- MCEWEN, F.L., Chairman, Dept. of Environmental Biology, University of Guelph, Guelph, Ontario.
- NORDIN, V.J., University of Toronto, Toronto, Ontario.
- ORLOB, G.B., Department of Botany, University of Toronto, Toronto, Ontario.
- PATRICK, Z.A., University of Toronto, Toronto, Ontario.
- PHILLIPS, C.R., Dept. of Chemical Engineering & Applied Chemistry, University of Toronto, Toronto, Ontario.
- SPENCER, E.Y., University of Western Ontario, London, Ontario.
- TOMECKO, J.W., University of Waterloo, Waterloo, Ontario.
- WEINBERGER, Pearl, Dept. of Biology, The University of Ottawa, Ottawa, Ontario.
- WEST, A.S., Queen's University, Kingston, Ontario.
- WRIGHT, Russell, Dept. of Environmental Biology, University of Guelph, Guelph, Ontario.

No.	Applicants	Location	Project Title	Amount Requested
1.	Alex, J.F.	University of Guelph	Biological control of St.John's-wort.	\$ 7,350.
2.	Boyer, M.G. Fowle, C.D.	York University	The response of bacteria, algae and invertebrates in small ponds to applications of mosquito larvicides.	12,260.
3.	Boyer, M.G.	York University	Application of benomyl and other systemic pesticides for the control of rust diseases of conifers.	4,556.
4.	Brown, J.R.	University of Toronto	Comparative study of the effect of Dursban and Abate on the growth of algae.	13,200.
5.	Chiba, M.	Brock University	Studies of the fate of oxamyl (Vydate), systemic nematicide and insecticide in plants and soil in relation to biological activity.	4,500.
5.	Chiba, M.	Brock University	Simultaneous determination of intact benomyl and its degradation product, methyl benzimidazol carbamate (MBC) in plants in relation to their biological activities.	4,200.
7.	Colman, B.	York University	The effect of mosquito larvicides on algal productivity and the uptake of inorganic substrates by photoplankton.	13,560.
8.	Corke, C.	University of Guelph	Interactions of pesticides and their metabolites with microbial transformations in soil and fresh water ecosystems.	4,040.
9.	Downer, R.G.H. MacKay, P.	University of Waterloo	Novel strategies for aphid control.	5,450.

APPENDIX III. (continued)

No.	Applicants	Location	Project Title	Amount Requested
10.	Downer, R.G.H. Mathews, J.R.	University of Waterloo	Development of new insecticide based upon inhibition of metabolic hormones.	\$ 3,175.
11.	Downer, R.G.H. Smith, S.M.	University of Waterloo	An investigation of side effects associated with the use of insect growth regulators for mosquito control.	2,800.
12.	Ellis, C.R.	University of Guelph	Economic threshold of cereal leaf beetle <u>Oulema melanopus</u> (Linnaeus) on oats and barley in Ontario.	10,480.
13.	Faulkner, P. Chadwick, J.M.	Queen's University	The utilization of insect polyhedrosis as an alternative to chemical pesticides: Studies aimed at characterizing the genetic stability of possible candidate viruses being considered for registration, and an investigation of acquired immunity of insect to the viruses.	16,850.
14.	Forer, A.	York University	The effects of selected pesticides on the meiotic spindle and on chromosome movements.	1,200.
15.	Fowle, C.D.	York University	Potential hazard to birds from granular formulations of pesticides.	5,907.
16.	Fushtey, S.G.	University of Guelph	Disease control in turfgrass - an integrated approach to control of <u>Helminthosporium</u> blights and <u>Sclerotinia</u> Dollar Spot	9,840.
17.	Gillespie, T.J. Sutton, J.C.	University of Guelph	Reduction of fungicide usage on vegetable crops by scheduling sprays according to weather data.	6,034.

APPENDIX III. (continued)

No.	Applicants	Location	Project Title	Amount Requested
18.	Harmsen, R.	Queen's University	Pest control and environmental protection optimization dynamic modelling study of pest control practices and environmental impact in the tobacco growing region of southern Ontario.	\$ 3,750.
19.	Inculet, I.I.	University of Western Ontario	Electrostatic application of pesticides	7,200.
20.	Kaushik, N.K.	University of Guelph	Effects of sublethal concentrations of diazinon on stream invertebrates.	7,930.
21.	Last, A.J.	Ontario Research Foundation	Control of pesticide drift by close sizing of liquid spray particles using ultrasonic and other specialized spray techniques.	99,000.
22.	Mackie, G.L.	University of Guelph	Effects of pesticides on growth and reproduction of non-target invertebrates of forest ponds.	11,750.
23.	Mayfield, C.	University of Waterloo	The effects of dipyridil herbicide on non-target organisms.	1,050.
24.	Mayfield, C.	University of Waterloo	The effects of the herbicide glyphosate on non-target micro-organisms in soil systems.	7,100.
25.	Mayfield, C.	University of Waterloo	The effects of the herbicide glyphosate on non-target micro-organisms in aquatic systems.	8,100.
26.	Mayfield, C.	University of Waterloo	Herbicide residues in organic soils.	6,200.

APPENDIX III. (continued)

No.	Applicants	Location	Project Title	Amount Requested
27.	McEwen, F.L.	University of Guelph	Control of the onion maggot, <u>Hylema antiqua</u> Meigen, by the use of the sterile male technique.	\$ 23,139.
28.	Ontario Fruit & Vegetable Growers Assoc.	Toronto	Biology and control of the crucifer flea beetle.	4,800.
29.	Ontario Fruit & Vegetable Growers Assoc.	Toronto	Spray application techniques to reduce pesticide load on row crops and to improve efficiency of control of pests.	3,800.
30.	Ontario Fruit & Vegetable Growers Assoc.	Toronto	To test the feasibility of implementing the pest monitoring system for apple growing areas of Ontario.	4,200.
31.	Safe, S	University of Guelph	Biodegradation and persistence of pesticides in a model ecosystem.	9,500.
32.	Spencer, E.Y.	University of Western Ontario	Persistence of residues of organophosphorous insecticides in organic soils used for vegetable production southwestern Ontario.	6,570.
33.	Spencer, E.Y. Miles, J.R.W.	University of Western Ontario.	Insecticide residues accumulating in organic soils used for vegetable production in southwestern Ontario and movement of these residues into adjacent drainage systems.	6,500.

APPENDIX III. (continued)

No.	Applicants	Location	Project Title	Amount Requested
34.	Stephenson G.R.	University of Guelph	Effectiveness of Bivert TDN and Nalco-Trol/Lo Drift for reducing herbicidal drift in roadside spraying.	\$ 2,000.
35.	Stephenson, G.R.	University of Guelph	Phytotoxic interactions involving metribuzin and other pesticides in tomatoes and potatoes.	10,368.
36.	Wilson's Laboratories	Dundas	Determination of acute toxicity of strychnine alkaloid.	1,750.
37.	Wright, R.	University of Guelph	Evaluation of mosquito larvicides.	10,520.

Total research funds requested in 1975-76	<u>\$ 360,629.</u>
Total research funds allocated to the Ontario Pesticide Advisory Committee in 1975-76	150,000.
Less 10% cutback	<u>15,000</u>
	\$ 135,000

APPENDIX IV.

Research projects supported by the Ontario Pesticides Advisory Committee, 1975-76

No.	Applicant (s)	Location	Project Title	Amount Granted
1.	Alex, J.F.	University of Guelph	Biological control of St. John's-wort	\$ 4,000.
2.	Boyer, M.G.	York University	The response of bacteria, algae and invertebrates in small ponds to applications of mosquito larvicides.	12,260.
3.	Brown, J.R.	University of Toronto	Comparative study of the effect of Dursban and Abate on the growth of algae	13,200.
4.	Chiba, M.	Brock University	Simultaneous determination if intact benomyl and its degradation product, methyl benzimidazol carbamate (MBC) in plants in relation to their biological activities.	4,200.
5.	Colman, B.	York University	The effect of mosquito larvicides on algal productivity and the uptake of inorganic substrates by photoplankton.	13,560.
6.	Corke, C.	University of Guelph	Interactions of pesticides and their metabolites with microbial transformations in soil and fresh water ecosystems.	4,040.
7.	Downer, R.G.	University of Waterloo	An investigation of side effects associated with the use of insect growth regulators for mosquito control.	2,800.
8.	Ellis, C.R.	University of Guelph	Economic threshold of cereal leaf beetle <u>Oulema melanopus</u> (Linnaeus) on oats and <u>barley</u> in Ontario.	4,500.

APPENDIX IV. (continued)

No.	Applicant (s)	Location	Project Title	Amount Granted
9.	Farquhar, G.J. Rover, C.A.	University of Waterloo	Study plan to monitor pesticide migration from waste disposal sites	0. *
10.	Forer, A.	York University	The effects of selected pesticides on the meiotic spindle and on chromosome movements	\$ 1,200.
11.	Fushtey, S.G.	University of Guelph	Disease control in turfgrass - an integrated approach to control of <u>Helminthosporium</u> blights and <u>Sclerotinia</u> Dollar Spot.	3,360.
12.	Gillespie, T.J. Sutton, J.C.	University of Guelph	Reduction of fungicide usage on vegetable crops by scheduling sprays according to weather data.	6,034.
13.	Inculet, I.I. Kelly, C.B.	University of Western Ontario	Electrostatic application of pesticides in orchards and field crops.	5,100.
14.	Kaushik, N.K.	University of Guelph	Effects of sublethal concentrations of diazinon on stream invertebrates.	5,554.
15.	Mayfield, C.	University of Waterloo	The effects of dipyridyl herbicides on non-target organisms.	1,050.
16.	Mayfield, C.	University of Waterloo	Herbicide residues in organic soils	6,200.
17.	McEwen, F.L.	University of Guelph	Control of the onion maggot, <u>Hylemya antiqua</u> Meigen, by use of the sterile male technique.	23,139.
18.	Ontario Fruit & Vegetable Growers Assoc.	Toronto	Biology and control of the crucifer flea beetle.	4,800.

APPENDIX IV. (continued)

No.	Applicant (s)	Location	Project Title	Amount Granted
19.	Ontario Fruit & Vegetable Growers Assoc.	Toronto	To test the feasibility of implementing the pest monitoring system for apple growing areas of Ontario.	\$ 4,200.
20.	Smith. S., Downer, R.G. Corbet, P. and Wright, R.	University of Waterloo University of Guelph	Mosquito control in Ontario	0. **
21.	Spencer, E.Y. Chapman, R.A.	University of Western Ontario	Persistence of residues of organophosphorus insecticides in organic soils used for vegetable production in southwestern Ontario.	6,570.
22.	Spencer, E.Y. Miles, J.R.W.	University of Ontario	Insecticide residues accumulating in organic soils used for vegetable production in southwestern Ontario and movement of these residues into adjacent drainage systems.	6,500.
23.	Stephenson, G.R.	University of Guelph	Effectiveness of Bivert TDN and Nalco-Trol/Lo Drift for reducing herbicidal drift in roadside spraying.	2,000
24.	Wilson's Laboratories	Dundas	Determination of acute toxicity of strychnine alkaloid.	1,750.
Total				\$136,017.

* Study funded in Fall of 1974 (\$4,000.) and begun in Winter of 1974-75.

** Study funded in 1973-74 (\$15,065.) and 1974-75 (\$8,175.) with completion expected in 1976.

APPENDIX V. Progress reports (Abstracts) on projects funded by the Ontario Pesticides Advisory Committee, 1975-76

1. Alex. J.F.* Biological Control of St. John's Wort.

St. John's wort, Hypericum perforatum L., a perennial plant introduced from northwestern Europe, is a weed of pasture land and disturbed natural vegetation in Ontario. It interferes with grazing capacity and, if eaten by susceptible light-skinned animals, causes photo-sensitization and severe sunburn under normal sunlight. Biological control by a leaf-eating beetle, used successfully in other countries and showing promise in British Columbia, was initiated by Agriculture Canada at one site in Ontario in 1969. The present study assembled ecological data on the weed and beetle, evaluated the effectiveness of the initial control attempt in Ontario, and established 5 new areas for release of the beetle and evaluation of its effect on the weed and associated vegetation.

St. John's wort occurs in nearly every county, district and region in Ontario. Several types or races were noted, differing in stem height, leaf and flower shape and size, flowering behaviour, size and number of non-flowering basal shoots, and growth as scattered individual plants or as dense colonies.

Early maturing seed generally germinated faster and more completely than later seed, but there were exceptions between sites. Failure to germinate did not seem to be due to inhibitors in the seed coat. In the field, minimal germination in soil under patches of the weed suggested autotoxicity to seedlings. Significant flowering of seedling plants in the first growing season occurred in only 2 out of 18 sites studied. Shading reduced flowering. Stimulated grazing had little effect on flowering but caused increases in number of shoots per crown and degree of erectness but reduced the dry weight of shoots and the shoot-root ratio. Vegetative spread within a site was the rule and few young vegetative shoots flowered in the first or second year of establishment.

The Chrysolina beetle established quickly at the initial Ontario release site and within two years had caused substantial control of St. John's wort and increases in other vegetation (grasses, alfalfa, other weeds). It over-winters as eggs laid on leaves of non-flowering basal branches produced in late autumn. Neither larvae nor adults had survived either winter in the two years of this study. Eggs hatch with resumption of spring growth of the weed. Larvae develop eating large quantities of leaves and soft stem tissue, then pupate in the soil. Adults emerge a few weeks later and feed voraciously on flowers and leaves, then re-enter the soil and aestivate. Aestivation is broken by fall rains, adults emerge, breed, and begin laying eggs. Migration of adults is chiefly by walking although it is correlated with wind direction. Beetles were released on 5 new sites in August 1974. Eggs were found later in the autumn in all sites and newly-emerged adults were found the following June in 2 sites. Egg mortality during the winter was from drying-out of the leaf or other surface on which the eggs were laid or fell. Good snow-cover would therefore be an asset to winter survival. Considerable data was gathered on the weed and associated vegetation prior to release of the insects. This will enable detailed evaluations to be made of the influence of the insect on pasture quality in future years.

*

_____ : Researcher(s) to whom grant was awarded.

2. Boyer, M.G., Fowle, C.D., and Butcher, J.E. The response of bacteria, algae, and invertebrates in small ponds to applications of mosquito larvicides.

The effects of Dursban ^(R) and Abate ^(R) on both chemical and biological factors in standing ponds were investigated over a period of two years from 1973. The results from this work are described in detail by Butcher in his MSc theses (York University).

The major conclusions from this project may be summarized as follows:

- 1) Dursban applied at rates from 0.004 to 0.1 ppm chlorpyrifos greatly reduced numbers of zooplankton for periods at least as long as 1 year.

- 2) At similar rates, the chemical markedly stimulated algal biomass and photosynthetic activity during the year it was applied. At the same time it reduced significantly the number of genera of algae, used as a measure of diversity.

- 3) Dursban at 0.1 ppm active ingredient but not at lower rates reduced the numbers of bacteria and their diversity, as estimated in several ways, up to a period of about 188 hours. No sustained effects were observed. However, when heterotrophic activity was estimated by the rate at which added organic material was colonized and degraded treatments appeared to have a detrimental effect.

- 4) When comparable experiments were run with Abate at 0.025 ppm and at levels above those usually applied in field studies, (up to 15 ppm) there was no indication that Abate behaved differently than Dursban with respect to the broad parameters studied.

The most significant result then with respect to both chemicals appears to be their ability to stimulate algae under the conditions existing in the artificial ponds.

Because of the adverse effects of Dursban and Abate on zooplanktonic forms release from the predatory activities of zooplankton is an obvious although unproven explanation of the increase in algae. Such an inference has been suggested in literature although no evidence was provided.

Other explanations are equally plausible. The quantity of phosphorus added, for example 0.009 ppm to 0.1 ppm Dursban and 0.003 ppm to 0.025 ppm Abate are well below detectable levels with the methods employed in this study. Nevertheless others have shown that there may be significant biological effects from the addition of small quantities of phosphorus. Other chemical factors, particularly micronutrients responsive to the addition of pesticides may also be implicated. The detection of such interaction much less their involvement poses a considerable problem.

In attempts to evaluate the relative merits of these two explanations of algal blooms the data will be examined from the standpoint of both level of treatment and time of treatment. The results should shed some light on whether chemical or biological factors are more significant.

Preliminary experiments have also been completed to assess the extent of predatory activity in our standing ponds.

3. Brown, J.R., Chow, L.Y and Deng, C.P. Comparative study of the effect of Dursban and Abate on the growth of algae.

A field study was undertaken to investigate the effect of application of diethyl 3,5,6-trichloro-2pyridyl phosphorothionate (Dursban^(R)) and O,O,O',O'-tetramethyl 0,0'-thiodi-p-phenylene phosphorothionate (Abate^(R)) on fresh water phytoplankton. For this purpose rigid cylinders comprising a steel frame surrounded by thick polyethylene envelope were constructed. These are more suitable than the unsupported structures used previously since they do not collapse.

Pure Dursban and Abate were applied in amounts which gave final concentration of 1.2,2.4,24,240 and 3.0,6.0, 60 and 600 ppb, respectively. As in previous years, Dursban exerted a toxic effect (reduction of growth) on most of the seven types of algae studied. The effect of Abate appeared to be equivocal and certainly was by no means as toxic as Dursban for the same algal types. These results were obtained from two complete growth cycles, one in June and one in July 1975. It should be stated that other workers have used a Dursban formulation which contains 7% glycol ether and 52% other vehicles. This may account for the difference in results between working groups.

Bioassays have been carried out, and there is some indication that Dursban and Abate depress growth. The presence of bacteria exerts a symbiotic effect in that in their presence there is augmentation in the growth of both Chlorella vulgaris and Ankistrodesmus falcatus var. acivulavis. The effects produced depend on the pH of the systems involved. Abate can be hydrolyzed at a pH greater than 8.0 and provides a source of phosphate in the medium.

From preliminary study of the summer work it would appear that Abate is less toxic to phytoplankton than is Dursban. The concentrations of the two larvicides used in this study are approximate to those used in field application.

4. Chiba, M. Development of a rapid spectrophotometric method for the simultaneous determination of benomyl and methyl 2-benzimidazole carbonate (MBC), and determination of the rate of degradation of benomyl in common organic solvents and water.

A simple spectrophotometric method was developed to simultaneously determine the concentration of intact benomyl and its degradation compound MBC in common organic solvents in water. Butylisocyanate was employed to stabilize benomyl in organic solvents except in alcohols. With an aqueous sample an equal volume of methanol was added prior to analysis.

Benomyl degraded slowest in chloroform and fastest in dioxane among solvents tested. In dioxane, 90% of 10 ppm benomyl degraded to MBC in 60 min. by standing at room temp. The degradation, however, stopped at a certain equilibrium point which was markedly affected by the total concentration of benomyl and MBC in the system and also temperature.

The rate of degradation in water was significantly affected by the kind and amount of dispersing agents. The addition of the surfactant Tween-20 accelerated the degradation.

The percentage of remaining benomyl at the end of 15 min. blending by an Omni-mix blender was 15%, 26% and 27% in chloroform, ethylacetate and benzene respectively, whereas with gentle shaking, the corresponding percentages were 92%, 68% and 85%.

The results indicate that the generally accepted view that benomyl rapidly degrades in water may be mistaken. Previous workers apparently overlooked the fact that benomyl is degraded in organic solvents during ordinary extraction procedures. Hence, even though there may have been intact benomyl residues in or on plant tissues and in water, they would not be present in the extract.

5. Colman, B. The effect of mosquito larvicides on algal productivity and the uptake of inorganic substrates by phytoplankton.

This project commenced in the fall of 1975 and a program report is expected in 1976.

6. Corke, T. Interactions of pesticides and their metabolites with microbial transformations in soil and fresh water ecosystems.

Studies on the effects of cyanazine and diuron, and their metabolites on the growth and fixation of nitrogen by three species of blue-green algae were completed. The growth responses of these algae to various concentrations of cyanazine, deethylated-cyanazine, diuron, DMU (3(3,4-dichlorophenyl), 1-methylurea, and 3,4-dichloroaniline were quantitated. The concentration ranges to produce 50% inhibition of growth were: cyanazine (0.04-0.05 ppm) deethylated-cyanazine (0.1-0.2 ppm), diuron (0.05-0.1 ppm), DMU (0.05-0.1 ppm), and 3,4-dichloroaniline (0.3-0.5 ppm). Nine other metabolites tested did not affect growth at 5 ppm.

Experiments on the interaction of pairs of the 5 phytotoxic compounds on growth indicated conclusively that phytotoxicity was additive. None of the herbicides inhibited nitrogen fixation at 5 ppm. Studies are in progress with the green algae Chlorella pyrenoidosa and Chlamydomonas reinhardtii, and the preliminary data indicate similar patterns of sensitivity to these compounds.

While formulated diazinon and Dursban^(R) inhibited nitrogen fixation by Anabaena spp, a wide range of concentration (varying from 0.05 to 2 ppm) was required to reduce acetylene reduction by 50%. This may reflect variation in formulations of solvents and cosolvents, or even in the state and concentration of the active ingredients. Technical grades of these insecticides had almost no effect on nitrogen fixation, at 5 ppm.

Possible interactions between herbicides and metallic ions on the growth of blue-green and green algae are under investigation. With some evidence we have hypothesized that sublethal concentrations of metallic ions may potentiate algal cells to greater sensitivity to herbicides. With this in view, the effects of concentrations of the ions of mercury, cadmium, chromium and nickel have been established on growth and nitrogen fixation of Anabaena inaequalis. The levels of ions to obtain 50% reduction in fixation are: 0.05 ppm (mercury), 0.2 ppm (nickel), 0.5 ppm (chromium) and 0.5 ppm (cadmium). Growth of algae was completely inhibited by 0.05 ppm mercury and 0.5 ppm nickel.

7. Downer, R.G. An investigation of side effects associated with the use of insect growth regulators for mosquito control.

Progress was delayed in 1975. A report is expected in 1976.

8. Ellis, C.R. Economic threshold of cereal leaf beetle Oulema melanopus (Linnaeus) on oats and barley in Ontario.

The cereal leaf beetle was first found in Canada in southwestern Ontario in 1965. The pest was widely distributed in Essex County by 1967 and economic damage occurred in 1973 and 1974. In 1974, fields of oats as far northeast as Wellington County were sprayed for cereal leaf beetle. This pest is increasing in importance in Ontario as the area of distribution and the population density both increase.

Tetrastichus julis, a parasite of larvae of the cereal leaf beetle, was released in Ontario in 1974, but probably had already spread to Ontario from release sites in Michigan by that time. A survey in 1975 confirmed establishment of T. julis in all areas where sufficient larvae could be found to sample. Parasitism ranged from 12% in the northwestern region to 95% near Guelph. This parasitism provides more incentive to carefully define economic injury levels and minimize pesticide application for cereal leaf beetle.

The peak populations of larvae of cereal leaf beetle in 1975 occurred from June 25th to July 4th. At this time all grain was in the shot-leaf stage and most fields were in an early head stage. More developed grain can tolerate more larvae without economic loss. This gives additional hope that Canadian data will provide a higher economic threshold for cereal leaf beetle than the present one based on U.S.A. data.

Four levels of larvae of cereal leaf beetle were caged on oats and barley at the shot-leaf stage and head stage of growth. Each treatment was replicated three times and results were subjected to an analysis of variance. Results are preliminary but in 1975 oats in the head stage tolerated 8 larvae/plant without yield loss and oats were more tolerated than barley. Two additional years of data are needed to provide reliable economic thresholds for oats and barley at the shot-leaf and head stage of growth. It is evident from 1975 data that a single threshold of 4-5 larvae/plant (irrespective of crop or stage of growth) as given for Ontario in the 1975 field crop recommendations is inadequate.

9. Farquhar, G.J., Rover, R.A. and A. Tewfik. Study plan to monitor pesticide migration from waste disposal sites.

In November 1974, Phase I of a study plan to monitor pesticide migration from waste disposal sites commenced. Phase I consisted of the collection and analysis of groundwater samples from the Cambridge, Guelph and Beare Road (Toronto) landfill sites. The pesticide analyses were done under the supervision of Dr. R. Frank, Director, Provincial Pesticides Residue Testing Laboratory. The purpose of the groundwater sampling at sites having received pesticides, or pesticide contaminated materials for disposal, was to study the extent of pesticide migration in a range of soil conditions.

Pesticides disposal suspected at the Guelph landfill site were triazines, phenoxy's, chlorinated hydrocarbons and mercury. On October 3 and 31, 1975, water samples were collected at the Guelph site from an on-site well and from two drains which collected generated leachate. The following pesticides were not detected: 2,4-D, 2,4,5-T, prometon, cyprazine, metribuzin, atrazine and di-ethyl atrazine. The pesticides detected were mercury, dicamba, MCPA, simazine, p,p'-DDE, p,p'-TDE and PCB. The detected pesticide concentrations were, in all cases, well below maximum permissible concentrations.

Coincident with an expected increase in rainfall infiltration through the disposal site during October, the pesticide concentrations in samples from the drains which collect leachate from the landfill increased markedly. For example, the DDT increased in a drain sample. During this same period, infiltration to the groundwater table would not be expected. This was observed to be the case with no significant changes in the pesticide concentration being recorded in the water sample taken from the on-site well.

With Ciba-Geigy using the Cambridge landfill site as a disposal site for contaminated containers and waste pesticides, the following pesticides were analyzed: triazines, phenoxy's, benapic acids, substituted ureas, toluidines, dinitriphenol compounds, organophosphates, chlorinated hydrocarbons, carbamates and mercury. Six on-site one municipal and one private, water wells were sampled on September 29 and October 31, 1975.

Assuming that the municipal and private wells are representative of background water quality for the area, it can be concluded that the land-filling operation has not affected the pesticide concentrations of the groundwaters monitored. All of the pesticide concentrations were well below the maximum permissible concentrations. In summary, low level concentrations of mercury p,p'DDE, and PCB were detected; traces of atrazine, trifluralin and carbaryl were detected.

Since the Cambridge landfill site is less than three years old, the lack of any environmental impact on the water quality by the fill operation is probably due to a lack of leachate production and/or slow migration rates through the low permeable soils. This does not say that pesticides will migrate in the future.

The pesticides, organochlorine and organophosphorus compounds, were suspected as having been disposed of at the Beare Road (Toronto) landfill site. On October 28 and November 26, 1975, two surface water, three on-site monitoring wells and five private water well samples were collected and subsequently analyzed. The p,p'-DDE, p,p'-TDE, p,p'-DDT PCB and O.P. concentration measured were well below the maximum permissible concentrations.

Similar to the Guelph site, an increase of DDT was recorded in November over that of October. This could be due to increased infiltration taking place.

The following preliminary conclusions are presented:

Pesticide concentrations in the leachate collected at the Guelph sanitary landfill site do not pose an environmental hazard. The pesticide concentrations measured in the leachate increased significantly as the rate of leachate production increased.

Similar concentration increases were observed for the Beare Road (Toronto) landfill site. However, the pesticide concentrations do not pose an environmental hazard.

The groundwaters at the Cambridge landfill site compared favourably to the background concentrations suggesting that the pesticide migration at this site is not being measured.

At this time it is thought that future work will be concentrated at the Cambridge site. Following the collection of some further background data, a series of monitoring wells will be installed at the site in the immediate proximity of the waste disposal area. It is proposed that this site offers the best potential for the evaluation of the hazards associated with the disposal of waste pesticides on land.

10. Forer, A. The effects of selected pesticides on the meiotic spindle and on chromosome movements.

No written report was submitted in 1975. A brief oral report was given at the seminar organized by the Advisory Committee in January, 1976.

11. Fushtey, S.G. Disease control in turfgrass - an integrated approach to control of Helminthosporium blights and Sclerotinia Dollar Spot.

During May, June and July of 1975 a total of 42 golf courses and 4 bowling greens, within a radius of about 60 miles from Guelph, were visited managed turfgrass areas examined and superintendents interviewed about turf disease problems. Where a problem existed and the cause was not obvious, samples of turf were brought back to the laboratory for additional diagnostic procedures. A primary objective in the visits was to collect information on the use of fungicides for disease control. Records were taken on what materials were being used, how much they were being used, how often, how much area was being treated, and how successful were these measures?

Interviews with superintendents, observations in the field and diagnostic laboratory procedures confirmed the author's assumption that the two major summer diseases of managed turfgrass areas in Ontario are Helminthosporium blights and Dollar Spot. Of the 56 records taken all but 2 indicated use of fungicides in one form or another for disease control. Some of these used the materials very sparingly, usually due to limitations imposed by low operating budgets, others used them extravagantly with no apparent limitations. The latter followed a prescribed preventive schedule with regularly spaced fungicidal treatments throughout the season regardless of disease incidence. Such usage is unwarranted and may eventually result in problems due to interference with activities of useful microbes in the soil.

Field trials on chemical control of the two major diseases were conducted at the Cambridge Research Station. The trial with Helminthosporium blight yielded no useful results because disease incidence was too low to permit assessment of control. The trial with Dollar Spot yielded particularly interesting results because the systemic fungicides, which are among the highly recommended fungicides for control of this disease, proved entirely ineffective. Subsequent laboratory study and reference back to the source of the fungi used to inoculate the experimental area, revealed a high level of resistance to this group of chemicals. Good control was achieved with contact fungicides containing mercury, chlorothalonil and a numbered experimental chemical.

The 1975 study facilitated the collection of useful information not previously available. The objectives of the project have been achieved in part but a continuation of the study for another year is indicated in order to realize the benefits of the information collected.

12. Gillespie, T.J., Sutton, J.C. and Swanton, C.J. Reduction of fungicide usage on vegetable crops by scheduling sprays according to weather data.

Progress with the Carrot Crop

A scheme, developed in 1973 and 1974 to maintain adequate control of carrot leaf blight caused by Alternaria dauci with minimum use of fungicides, was tested in commercial growers' fields during 1975. The scheme utilized information on temperature, leaf wetness duration, sunshine, and current disease level to decide the timing of sprays. Results were very encouraging, as indicated by the table below.

Site	Spray Program	Percent leaf area diseased at harvest	Number of fungicide sprays
Grower A	Regular calendar	9.0	6
Grower B*	Timed	2.8	4
Grower C	Timed	2.3	2
Grower D	Timed	1.0	2
M.R. Station	"	2.4	2

* Grower B required more sprays than the other timed test areas because the disease appeared earlier on his farm.

The fungicide scheduling scheme was successfully co-ordinated with Dr. A.B. Stevenson's (Agriculture Canada) scheme for timing insecticide sprays for carrot rust fly. When necessary, both materials were applied together in one trip through the field and insecticide was never applied alone.

Progress with Onion Crop

A regular 7 to 10 day fungicide spray program is used by many onion growers to reduce leaf spot damage due to Botrytis squamosa. We are attempting to specify the weather conditions conducive to onion leaf spot disease and hence to reduce fungicide usage on this crop by withholding sprays during periods unfavourable for disease progress.

Unsprayed and regularly sprayed plots of two onion varieties (Autumn spice and Sunburst were maintained at the Much Research Station (Bradford) along with plots where sprays were timed according to rather scanty information on *B. squamosa* available in the literature. The following data were obtained at harvest in the first week of September, 1975:

Treatment	No of sprays	Lesions on 80 plants
No spray	0	2388
Regular spray	11	426
Timed spray	6	379

No significant difference in yield was found between the two spray treatments but the unsprayed yields were significantly lower. Controlled environment studies are underway to specify more precisely the rules that should govern fungicide spray timing on onions.

13. Inculet, I.I. and Kelly, C.B. Electrostatic application of pesticide in orchards and field crops.

Experimental results are presented on a method of spraying liquid mixtures of pesticides in orchards utilizing electrostatic charging of the droplets generated by a standard commercial nozzle (Kinkelder).

Experiments were performed at the research orchard of the University of Guelph and under laboratory conditions at the University of Western Ontario. The tests were carried out with and without voltage applied (60 kV). Deposition counts on the same leaves show that the coverage was noticeably improved by the application of high voltage, and, in particular, in the amount of pesticide that was deposited on the underside of the leaves. For the same spraying duration, the experiment performed at the research orchard showed that for the uncharged test only about 15 percent of the leaves had any deposition on the underside compared to 51 percent in the charged case.

The results are summarized below for a two minute spray of 2.16 litres of mixture.

Table 1

Field Experiment - Live Tree- Total Count

Deposition	Charged Spray		Uncharged Spray	
	Front and Back Side	Back Side	Front and Back Side	Back Side
H	4%	2%	0%	0%
M	13%	9%	8%	0%
L	53%	40%	32%	15%
Zero	30%	49%	60%	85%

Laboratory Experiment - Artificial Tree - Total Count

Deposition	Charged Spray		Uncharged Spray	
	Front and Back Side	Back Side	Front and Back Side	Back Side
H	44%	37%	33%	33%
M	44%	46%	42%	25%
L	12%	17%	25%	42%
Zero	0%	0%	0%	0%

It is believed that by making some modifications to the existing orchard sprayers, the electrostatic charging could be added to them without the need of purchasing new equipment.

14. Kaushik, N.K. Effects of sublethal concentration of diazinon on stream invertebrates.

The two main objectives of the study were to investigate changes, if any, in the pattern of diversity of stream benthos exposed to prolonged and repetitive introduction of low levels of diazinon and to investigate effects of transient and prolonged exposure to sublethal doses of diazinon on invertebrate activities (behaviour, reproduction, feeding, etc.).

For the first objective, studies were carried out in a moderately fast-flowing reach of the Speed River. This part of research also involved studies on the times-of-travel and dilution profiles of diazinon and fluorescent dye, Rhodamine B. The two compounds were simultaneously introduced at a constant rate into the stream and their concentrations determined at various downstream points. Results indicate no sink for either substance and their downstream transport and dispersion were coincident, suggesting that Rhodamine B could be a useful tracer for diazinon.

From July 9th to September 21st, 1975, diazinon was introduced into the Speed river on every third day to obtain an equilibrium concentration of 0.06 mg diazinon/L, over a dosing period of 40 minutes. Colonization of basket samplers and 'kick' samples were used to assess species diversity and abundance at points below and above the dosing site. Drift nets were used to discover any change in species comprising the drift population. Analysis of the results of this experiment though not yet completed indicate no major effect on species abundance.

As a part of the second objective Chironomus tentans (Dipt; Chironominae) was reared through one generation in diazinon solutions containing fractions of the 48H LC50 for the 28 day old larvae. The results show a lengthening of the duration of the life cycle and a reduction in the reproductive potential with a concentration as low as 1/500 18H LC50 (0.006 ug diazinon/L).

Also Gammarus pseudolimnaeus (Crustacea; Amphipoda) were kept in diazinon solutions containing fractions of the 96H LC50 for mature adults. The duration in precopula was observed over a period of 5 days. The results show that whilst 0.02 ug diazinon/L increased the duration, 0.1 ug diazinon/L significantly decreased the duration in precopula.

15. Mayfield, C.I. The effects of dipyridyl herbicides on non-target organisms.

An improved analytical procedure for paraquat in soil was developed. Using this method the absorption of paraquat by various soils and soil components was studied. The mobility of absorbed paraquat on these components when subjected to elution by water and various ions was studied. Certain ions (especially ammonium) eluted paraquat from soils and caused migration. The degradation of paraquat in a number of soils and artificial systems was studied. No detectable biodegradation occurred in systems which had no added nutrients. Photodecomposition of paraquat did occur and was significant. Radioisotope studies in the laboratory confirmed these results. Field studies demonstrated a loss of paraquat after spraying due to photo-decomposition and some leaching. Most of the paraquat applied remained in the surface 2 cm of the soil.

Paraquat affected the growth and activities of urea-decomposing, nitrogen-fixing (symbiotic and non-symbiotic), cellulolytic and nitrifying bacteria in soil. The total soil microflora also responded to paraquat application in terms of total numbers and species composition. Most of the effects of paraquat observed in activities of soil microorganisms were apparent only at rates of application higher than those used in the field although the concentration at the surface of sprayed soils could produce zones in these soils where the level of herbicide is high enough to affect microbial activity.

16. Mayfield, C.I. Herbicide residues in organic soils.

The persistence of various herbicides used extensively in vegetable production is being investigated. The herbicides chosen for the study are: Linuron, Prometryne, CDA (Radox), Dalapon and CIPC. Residue analysis and soil extraction methods for these herbicides are being tested. Wherever possible, (all except CDA) gas chromatographic methods plus spectrophotometric methods are being used. No gas chromatographic method is currently available for CDA. Studies with Linuron are more advanced than with the other herbicides and three analytical methods have been tested, two of which (a gas chromatographic and a spectrophotometric method) are satisfactory. Using these methods, samples of organic soils, with a known history of herbicide application, have been analyzed and significant quantities of Linuron have been tentatively identified six months after application. Field assays will continue on these (and other) soils.

Laboratory experiments have shown no significant decrease in added Linuron concentration in soils maintained under a wide range of environmental conditions (temperature and moisture content) for (at present) up to 30 days.

17. McEwen, F.L., Tolman, J.H. Svec, H.J. and Harris, C.R. Control of the onion maggot, *Hydomya antiqua* Meigen, by use of the sterile male technique.

During 1975, onion maggots were reared in the facilities at Agriculture Canada, sterilized with gamma radiation, and released in the Keswick Marsh against the second generation of the onion maggot. Growers in the Keswick Marsh, with approximately 250 acres of onion, cooperated in this program. Growers used two applications of chlorprifos, supplied gratis by Dow Chemical Company, to control the adults of the first generation and, in addition applied ethion-thiram in the furrow at planting time to control any maggots that were produced. The approach was to reduce the overwintered population drastically during the first generation and then to release the sterilized flies against the second generation, in July. This plan was carried out and releases were made during July and August. Releases were made twice each week. Approximately 6 million flies were released against the second and early stages of the third-generation, and population were monitored in the field to determine the percentage of released versus wild flies in the total population. In addition, observations were made on egg hatch in comparison to hatch in areas where no release had been undertaken. Results showed a slight decrease in egg hatch where the release had been made, and this was consistent with the observations on the relative numbers of released and wild flies in the total population. Although the number of flies released should have maintained an irradiated to wild population ratio of approximately 5:1, in general, the ratio was less than 0.5:1. Contrary to results of previous years, released flies did not survive well in the wild in 1975. Because of the poor success against the second generation attack, it was decided to recommend to growers that chemical sprays be applied against the third generation. Not all growers applied such sprays.

Year 1975 was an unusual one in that it was extremely hot and dry during the month of July, when the adults of the second generation were at their peak. Probably as a result of this, very few eggs were laid, and despite the fact that our releases did not reduce the hatch of eggs to the desired level, no damage was sustained from the second generation attack.

In relation to the sterile-male release program, an experiment was conducted in which pupae were released from an aircraft at altitudes of 30-300 meters. The swath width of the pupae on the ground from each drop was recorded and pupae were collected from drops at two altitudes and taken to the laboratory for emergence. Flying at altitudes of 30-300 meters, swath widths of the pupae were 15-16 meters with a wider band at increased altitude. Emergence from dropped pupae was not impaired.

In experiments during 1973, 1974 and 1975, onion maggot pupae have been irradiated at a dosage of 4 krad. This dosage has been used to ensure that released insects will be sterile. In earlier experiments it has been found that with dosages of .5, 1.0 or 2.0 krad, some eggs hatched and larvae were produced. An experiment was conducted to determine the survival rate of the larvae produced from irradiated parents. Laboratory experiments at .5, 1.0 and 2.0 krad showed that despite the fact some eggs hatched following these treatments, larval survival was very low.

Studies were also initiated to assess the feasibility of utilizing a chemosterilant rather than radiation. IFMPA (hexamethylphosphoramid) is known to be an effective sterilant against a number of different insects.

Studies were initiated to determine whether the onion maggot, Hydomya antiqua was subject to sterilization by Hempa, and if so, whether methods could be developed to utilize this compound in a sterile insect release program.

Flies from laboratory cultures were effectively sterilized by feeding a 5.0% sucrose solution containing 0.1% (v/v) Hempa for a period of 48 hours. Flies emerging from diapause required a higher concentration (0.5%) to elicit sterility. Chemosterilized flies were competitive in laboratory experiments, a 5:1 ratio of sterile: fertile flies reducing egg hatch to 10% or less over the course of a 35-day experiment.

Field release of chemosterilized flies met with limited success. A total of 350,000 flies were released over a period of 15 weeks following a pattern predicted by accumulating thermal units. Ratios of released native flies exceed 5:1 on two occasions- 2 weeks in August and 3 weeks in September. While the average 40% depression of hatch of eggs from flies collected from the study area was not as pronounced as predicted, an expected third peak in the fly population did not develop. Maggot damage to onions in the study area was negligible.

18. Ontario Fruit and Vegetable Grower's Association

(Kinoshita, G.B., Harris, C.R., Svec, H.J. and McEwen, F.L.)
Biology and control of the crucifer flea beetle.

The crucifer flea beetle, Phyllotreta cruciferae (Goeze) was introduced to Canada from Europe in 1923 and has been a sporadic pest of cruciferous crops both on the prairies and in eastern Canada. Recently in Ontario, flea beetle populations have been on the increase and there have been numerous reports of crop damage during the past few years. The biology of the flea beetle in Ontario has not been fully investigated, hampering the development of more effective control programs. We therefore conducted a detailed laboratory and field study on crucifer flea beetle biology and control.

Possibly because of its small size and habits the crucifer flea beetle has never been reared successfully. However, using controlled environmental conditions a rearing technique was devised and continuous culture has been maintained since 1974. Crucifer flea beetle eggs require 5 days for development at 25°C. There are three larval instars over 12-13 days while prepupal and pupal stages lasted 13-15 days.

Studies on life history in the field indicated that the flea beetle overwinters either in the field under crop refuse and in soil or under leaf litter at the perimeters of the field. Sticky traps were used to monitor beetle populations. In 1975 overwintering adults appeared in the field in April and there were 2 complete generations peaking on July 2 and August 13.

A survey was conducted in 1975 to determine the importance of the crucifer flea beetle in major crucifer-growing areas of southwestern Ontario and control measures used. The beetle was a major pest of crucifers in some areas of Middlesex, Halton and Wentworth counties, minor in Wellington and Norfolk and not a problem in Essex or Kent.

The contact toxicity of a large number of insecticides to field-collected adults was determined by laboratory bioassay. Dosage-mortality lines were constructed for the most effective materials. Few of the compounds tested were more effective than those presently recommended for use in Ontario. Since soil type and moisture influence insecticide toxicity and because the various flea beetle stages develop largely on or in soil, the efficacy of several insecticides in soil was assessed in the laboratory prior to field tests. Diazinon and carbofuran were most toxic in either mineral or organic

soil. Chlorfenvinphos is relatively effective in mineral soil, much less so in muck. Temperature also influences insecticide toxicity. After primary screening tests with several insecticides dosage-mortality lines were determined for insecticides showing greatest temperature effects. Endosulfan had a positive temperature coefficient, DDT and FMC 33297 were negative.

It has been suggested that increased incidence of flea beetle damage to crucifers may be associated with declining residues of DDT and dieldrin in agricultural soils. A 2-year study indicated that residue levels of dieldrin and DDT typical of those present in soils used for crucifer production in Ontario in the late 1960's, effectively suppressed flea beetle populations, i.e., the use of dieldrin and to a lesser extent DDT for cabbage maggot control resulted in "accidental" suppression of flea beetles. As these residues decline below biologically active levels in soil more emphasis will have to be placed on flea beetle control.

Field tests in 1974 indicated that insecticides presently recommended for use in Ontario for adult control are effective. As flea beetles burrow into soil on cool days and nights (typical spring conditions) it was suggested that planting-water treatments used for cabbage maggot control might also provide some degree of flea beetle control. Microplot field tests indicated that azinphosmethyl, diazinon and chlorfenvinphos were effective. Carbofuran and fensulfothion were phytotoxic to cabbage transplants. The effectiveness of several granular insecticides for flea beetle control in seed beds was also assessed in microplot tests. Counter and oxamyl were effective. The synthetic attractant, allyl isothiocyanate, although a useful tool in monitoring for crucifer flea beetle appearance in spring, was not effective in reducing beetle populations in crucifer transplants.

19. Ontario Fruit and Vegetable Grower's Association. To test the feasibility of implementing the pest monitoring system for apple growing areas of Ontario.

No written report was submitted in 1975. A brief oral report was given at the seminar organized by the Advisory Committee in January, 1976.

20. Smith, S. Downer, R.G., Corbet, P. and Wright, R. Mosquito control in Ontario

This study was initiated at the request of the Advisory Committee, with funds being provided in both 1974 and 1975. A final report was submitted in January, 1976. The Advisory Committee plans to utilize data in the report as a basis for preparing recommendations on mosquito control programs in Ontario.

21. Spencer, E.Y., and Chapman, R.A. Persistence of residues of organophosphorus insecticides in organic soils used for vegetable production in southwestern Ontario.

The concentrations of Chlorpyrifos, phorate and terbufos in treated sand and muck maintained in field microplots were determined at selected intervals after application. A comparison of the percentages of the initial concentrations remaining after 8 weeks showed that chlorpyrifos was much more persistent in muck, terbufos was moderately more persistent in muck and phorate was equally persistent in muck and sand. Large amounts of phorate and terbufos were oxidized to the corresponding sulfoxide and sulfone. Oxidation of the parent materials and retention of their oxidation products was four to five times greater in muck than in sand. Terbufos sulfoxide appeared much more resistant to oxidation than phorate sulfoxide. Oxychlorpyrifos levels were generally less than 0.001 ppm, but concentrations of 3,5,6-trichloropyridinol representing up to 14% of the initial chlorpyrifos treatment were observed and found to be more persistent in muck. Residues in carrots and radishes were less than 0.1 ppm except for phorate sulfoxide and terbufos sulfoxide and sulfone in the respective sand treatments.

22. Spencer, E.Y., Miles, J.P.W., and Sharom, M.S. Insecticide residues accumulating in organic soils used for vegetable production in southwestern Ontario and movement of these residues into adjacent drainage systems.

Our assessment of insecticide residues in organic soils has been carried out at the Holland Marsh where concentrated vegetable production requires the use of many insecticides on crops and soil. We have analysed for insecticide residues in soil, water, sediment and fish, and by combining pumping data and insecticide concentrations in water we have calculated the amounts of insecticide chemicals pumped from the marsh. Numerous insecticide residues have been found in the muck soils e.g. DDT and its metabolites DDE and DDD, aldrin, dieldrin, endrin, endosulfan, Birlane(R), diazinon, Dursban(R), Dyfonate (R), ethion, parathion and VC 13. Concentrations of some insecticides in the soil are quite high - (DDT up to 60 ppm, ethion up to 25 ppm) but considerable dilution must accompany erosion since concentrations of insecticides in the bottom sediment of the drainage ditches are only in the part per billion range.

Concentrations of insecticides in the drainage ditch water have generally been less than 1 part per billion. Concentrations greater than 1 part per billion in water have occurred during the summer when there is little or no pumping from the drainage ditch into the Schomberg river.

The organophosphorus insecticide ethion appears to be quite persistent and its residues carry over in soil in the year following application. Organochlorine insecticides and also ethion are associated with the sediment and tend to be pumped out in larger quantities in spring when large amounts of sediment move at the time of thaw and spring rains. Diazinon on the other hand partitions into the water and reaches higher concentrations in summer.

Amounts of insecticides pumped from the marsh vary from year to year. In 1972 and 1974 more organochlorines than organophosphorus insecticides were pumped out of the marsh, but in 1973 slightly more o-p's than o'c's were pumped into the Schomberg river.

Traces of two organophosphorus insecticides, diazinon and ethion were found in fish in the drainage ditch in 1974.

Adsorption and desorption of 10 insecticides by agricultural soils and stream sediments and persistence of these insecticides in water were studied in the laboratory. Organochlorine insecticides were adsorbed onto the soils or sediment as follows: DDT > dieldrin > endrin > lindane. Of the organophosphorus insecticides tested leptophos was most strongly adsorbed > ethion > chlorpyrifos > parathion > diazinon > mevinphos. In general the least water soluble insecticides showed the greatest degree of adsorption. Bradford muc. had the highest adsorptive capacity > Big Creek sediment > Beverly sandy loam > Plainfield sand. K values obtained from desorption studies generally agreed with those of the adsorption studies indicating that insecticides with the highest water solubility were desorbed in the greatest amounts. Tests on persistence of the insecticides in water indicated that more than 50% of the initial amounts of dieldrin, endrin, ethion, and chlorpyrifos remained in both natural (collected from the Holland Marsh drainage system) and distilled water after 18 weeks incubation, i.e. these insecticides were relatively persistent in water. Other compounds disappeared more quickly. Degradation in water may be either chemical or microbial. The latter may play a role in degradation of parathion, DDT, diazinon, leptophos and lindane. DDT degraded rapidly in natural water to DDD, parathion to aminoparathion.

23. Stephenson, G.R. Effectiveness of Bivert TDN and Nalco-Trol/Lo Drift for reducing herbicidal drift in roadside spraying.

Bivert TDN, an invert emulsion and Lo-Drift/Nalco-Trol (a poly vinyl polymer) were evaluated for reducing spray drift under conditions equivalent to roadside spraying at Centralia airport in mid July 1975. Two John Bean sprayers equipped for roadside spraying with a swath width of approximately 6.1 m were employed; one for Bivert TDN and the water control and one for the Lo-Drift/Nalco-Trol. Two peacock nozzles (No. 41-90) were employed for all treatments. Vehicle speed was 13 km/hr and vehicle direction was from east to west. For the first two replications the wind was from the southwest at an angle of approximately 45° across the path of the vehicle. For the third replication the wind was out of the south at right angles to the vehicle path. Wind velocity was never lower than 11 Km/hr or higher than 14 Km/hr for any of the treatments. A spray drift trapping grid was set up for each of the treatments which consisted of a series of 3.6 m poles at 3 m intervals in a line from a point 6.1 m south (up-wind) to a point 21.3 m north (down-wind) from the 6.1 m swath or target area. The spray drift was intercepted by petri dishes containing filter paper placed at 0.3 m intervals on each of the twelve poles in the grid. Fluorescence and Tordon 101 were added to each 227 L of spray at rates of 0.45 Kg and 9.1 L to facilitate later evaluation under ultra-violet light and bioassay.

Examination of the petri dishes for fluorescence deposits under UV light revealed significant drift (greater than 15 droplets/dish) for all three water treatments to at least 15.2 m down-wind from the target area. For the first replicate of Bivert TDN, the invert emulsion had not yet formed when the spray trapping grid was passed and significant drift of fluorescence was observed. For all other replicates of Bivert TDN and Lo-Drift/Nalco-Trol no significant drift of fluorescence was observed beyond a distance of 6.1 m from the target area.

A cucumber root inhibition bioassay was developed to quantify the actual amount of 2,4-D picloram intercepted by each petri dish in the spray trapping grid. The standard curve was established by spraying petri dishes with a range of 2,4-D + picloram concentrations from 0 to 5 Kg/ha. The curve was linear and repeatable over a range of concentration from 10^{-7} to 10^{-1} Kg/ha. An application of 10^{-1} Kg/ha was equivalent to 0.3 mg 2,4-D + picloram per petri dish. The total intercepted spray outside of a defined target area (0 to 6.2 m down-wind from the road edge and 1.5 m in height) was then determined for each treatment. With this quantitative method it was established that the total intercepted spray drift was 10 to 10,000 times greater for the three standard water treatments than for any of the Lo-Drift/Nalco-Trol or Bivert TDN treatments. The only exception was the one Bivert TDN replicate which was not properly inverted when the sprayer passed the spray trapping grid.

24. Wilson Laboratories. Determination of acute toxicity of strychnine alkaloid.

This study was initiated at the request of the Advisory Committee. Results have been submitted to the committee and forwarded to the appropriate agencies.

APPENDIX VI. Publications, theses, and papers submitted to scientific conferences April 1, 1975 - March 31st, 1976.

Brown, J.R., Chow, L.Y. and Ong., C.B. 1975. Effect of Dursban upon fresh water phyto-plankton. Bulletin Environmental Contamination and Toxicology, In Press (1975).

Butcher, J.M. Boyer and C.D. Fowle, 1975. The impact of Dursban and Abate on microbial numbers and some chemical properties of standing ponds. Proceedings of 10th Canadian Symposium on Water Pollution. Research: 33-41.

Harris, C.R., Svec, J.J., Sans, W.W., Hikichi, A., Phatak, S.C., Frank, R., and Braun, H.E. 1974. Efficacy, Phytotoxicity, and persistence of insecticides used as pre-and postplanting treatments for control of cutworms attacking vegetables in Ontario. Proc. Entomol. Soc. Ontario. In Press (1975).

Langenberg, W.J., Gillespie*, T.J. and Sutton, J.C. 1975. Carrot leaf blight (Alternaria dauci) development in relation to environmental factors and fungicide applications. Master's thesis presented to the Faculty of Graduate Studies, University of Guelph.

Vanderpost, J.M., Corke,*C.T. 1975. The effects of heavy metals on the Rhizobium metilotic Medicago sativa nitrogen fixing symbiosis (alfalfa). Master's thesis presented to the Faculty of Graduate Studies, University of Guelph.

* Principal Investigator and Supervisor of Graduate Student.

